Mast from classic racing yacht holds one of the keys to sustainable biofuels

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(PhysOrg.com) -- The mast from a classic racing yacht and samples from a Forestry Commission breeding trial have played a key role in the search for sustainable biofuels.

Cellulose is the most abundant organic polymer on earth — and therefore a potentially major source of glucose for the production of biofuels. But its structure in wood and plants is so complex it needs a combination of enzymes to degrade it — making the process difficult and costly.

Now, for the first time, a team of international experts, which involved The University of Nottingham, has described the detailed structure of cellulose fibres in wood. Their research will be crucial in the future development of strong, sustainable composite materials and second generation biofuels and has just been published in the leading academic journal *Proceedings of the National Academy of Sciences*.

A detailed structure of crystalline cellulose in algae was produced a decade ago. But only about half of the cellulose in wood fibres and crop plants is crystalline, the rest is disordered. The challenge was to find out how the crystalline and disordered parts fit together.

Ten years on Dr Anwesha Fernandes a biophysicist in The University of Nottingham's Centre for Plant Integrative Biology — in collaboration with experts from The University of Glasgow, The University of Bath, the New Zealand School of Forestry, the Institut-Langevin in France, Keele University, Durham University and Historic Scotland — has helped us understand how plants make cellulose and how the cellulose that they make defines their shape and provides their mechanical strength — everything that makes wood so slow to decay and so difficult to convert into biofuel.

Dr Anwesha Fernandes, a biophysicist in the Centre for Plant Integrative Biology, said: "Biofuels are produced by breaking down the cellulose in raw material into glucose. The glucose is then fermented to bioethenol. Breaking down the cellulose is the most difficult part of the process. So understanding the make-up of cellulose is a major break-through in the development of enzyme-based technology for the production of biofuels."

The research required wood in which the cellulose was particularly uniformly oriented, giving it a very high strength to weight ratio. The scientists chose Canadian Sitka spruce wood from a classic racing yacht's mast. This wood is thought to have been harvested in the 1940s for aircraft construction during WWII. They also used Sitka spruce samples carefully selected from a Forestry Commission breeding trial. The best of this material was comparable with the old-growth Canadian wood.

Dr Fernandes said: "Our experiments with spruce wood cellulose showed that although the cellulose fibres were bundled together their surfaces were more accessible than previously thought. In fact some of the surface area was of a type to which enzymes are known to bind. The findings will help in the development of enzyme-based technology for making biofuels."

Dr Anwesha's work originated in the laboratory of Dr Michael Jarvis in the Department of Chemistry at the University of Glasgow. The collaborations continued when she joined The University of Nottingham.

More information: The full paper can be found at: www.pnas.org/content/early/201 … 942108.full.pdf+html

Provided by University of Nottingham

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